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## ORDOVICIAN (?) FISH REMAINS IN COLORADO

DURING the past year Mr. P. G. Worcester, of the Colorado Geological Survey, has been investigating certain strata near Ohio City, Colorado, supposed to be of Ordovician age. The particular horizon under discussion contains *Receptaculites oweni* Hall (southeast of Fairview Mt.), *Halysites catenulatus* (L.) (basin east of north end of Fossil Ridge), *Platystrophia* (?) sp. (Fossil Ridge), and *Heliolites* (?) sp. with *Halysites catenulatus* at head of Alder Creek, west of Fossil Ridge. The *Heliolites* (?) is the same as that in the Cañon City Ordovician. These fossils were identified by Professor J. Henderson, and so far as it is possible to determine from them, the rocks should certainly be Ordovician. The first Devonian fossils were found about 100 feet above this horizon.

However, closely associated with the invertebrates cited, and certainly of the same age, are rather numerous fragmentary remains of fishes. These may be briefly described as follows:

1. A fragment of a plate exhibiting fine grooves with deep pits; resembling, so far as it goes, the plate of *Coccosteus dissectus* from the Old Red Sandstone, figured by A. S. Woodward, Cat. Fossil Fishes Brit. Mus., Part II, pl. VIII, fig. 1. The structure is also nearly identical with that of *Astraspis desiderata*, from the Ordovician of Cañon City, as figured by Walcott, Bull. Geol. Soc. Amer., Vol. 3 (1891), pl. 3, f. 7. Some of the other figures of *Astraspis* might well belong to Coccostean fishes.

2. A large fragment, having a diameter of over 30 mm., is covered with irregular obtuse vermiform ridges, and is *exactly* like the opercular plate of *Rhizodus ornatus* (Woodward, t. c., pl. xii, f. 5). so far as the sculpture goes. This particular species is lower Carboniferous, but Rhizodontid fishes also occur in the Devonian.

3. Numerous fragments of striated spines, some short, conical and straight; others more slender and curved. These appear to exactly correspond, so far as they go, with the spines of *Diplacanthus*, from the lower Old Red Sandstone. One of the supposedly Coccosteoid plates, 5 mm. thick, with the surface finely striate, with punctate more or less branching striæ or grooves, occurs in the same piece of rock as a supposed *Diplacanthus* spine, the two almost touching.

According to the available evidence, we seem therefore to

have three families of fishes represented: (1) *Coccosteidae*; (2) *Rhizodontidae*; (3) *Diplacanthidae*. The genera and species can not be precisely determined.

These fish remains, taken by themselves, would certainly be regarded as Devonian. Walcott's Ordovician species from Cañon City were said by Professor James Hall to have such a Devonian facies that he would certainly have referred them to the Devonian, but for the accompanying invertebrate fauna.

In general, when there is a conflict between the evidence from vertebrate and invertebrate fossils, the vertebrates must be allowed the most weight; but it is evident that the numerous and varied Devonian fishes had ancestors, so it is to be expected that types more or less like those of the Devonian will be found in older rocks. I understand from Mr. Worcester that there is no reason to believe that the Silurian is represented in the locality.

Schuchert ("Paleogeography of North America") remarks that in the Ordovician or Ordovician, during the retreat of the sea,

The first evidence of those peculiar heavily armored fishes belonging to the ostracoderms appears in cleanly washed beach sands and less abundantly in dolomites at three widely separated places in Colorado and Wyoming. They are now all fragmentary and seem to have been washed into the sea by the rivers. From this can it be inferred that during some earlier inundation the marine ancestors of these fishes were retained upon the land in relict seas, and under the stress of evanescent waters became modified into the armored double-breathing animals that gave rise later to the true fishes? Such being the interpretation, the marine fishes must then have been derived from land [freshwater] fishes, as suggested by Chamberlin and Salisbury.

The two localities in addition to the famous one at Cañon City are (Dr. Eastman in litt.) in the Big Horn Mts., and in the Black Hills uplift, in a bed lying above the Deadwood Formation. Both were discovered by Mr. N. H. Darton. These all agree in the character of their fish remains.

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